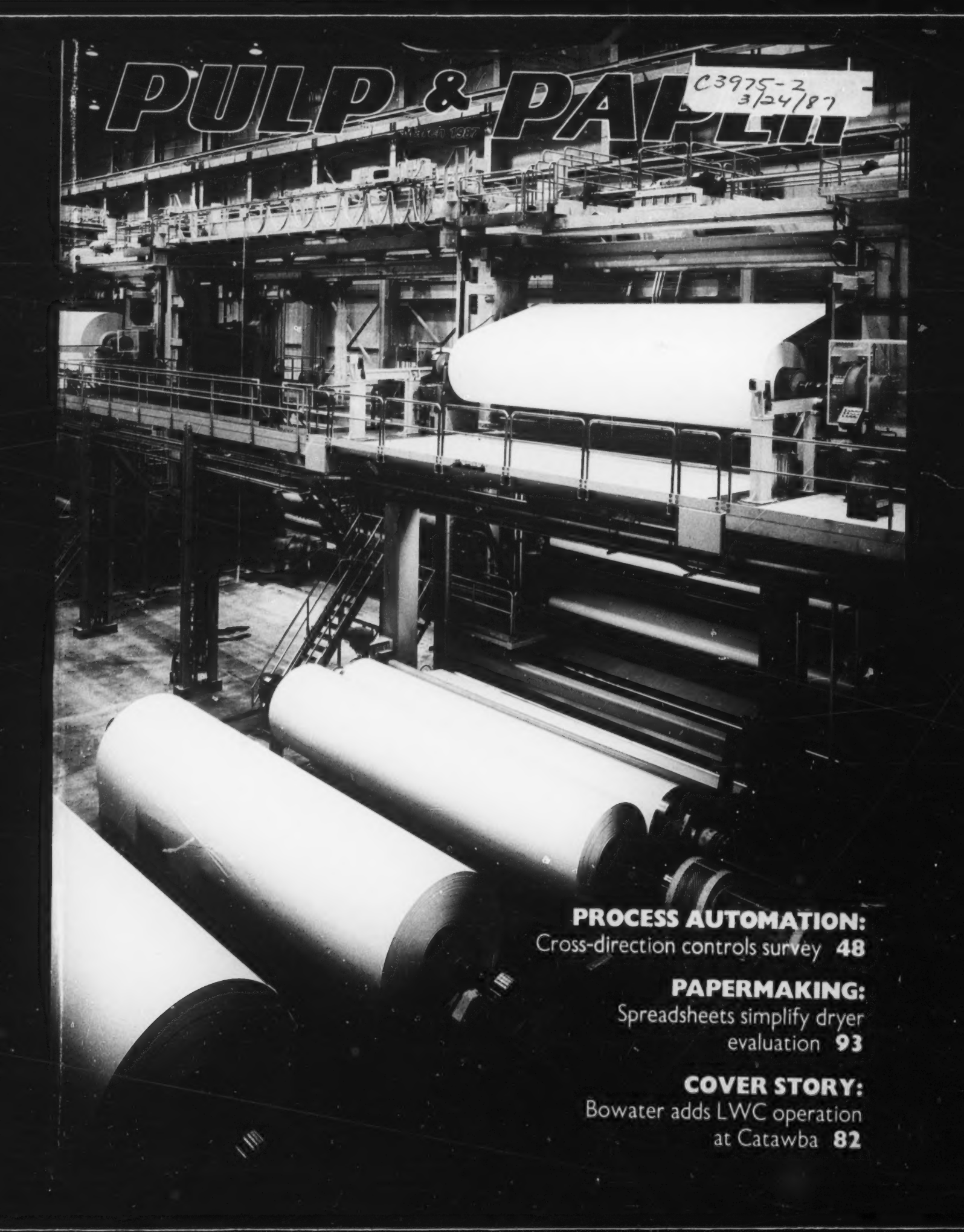
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(Photo courtesy of Bowater Carolina Co.)

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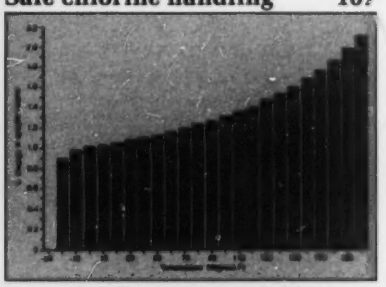

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PULP&PAPER

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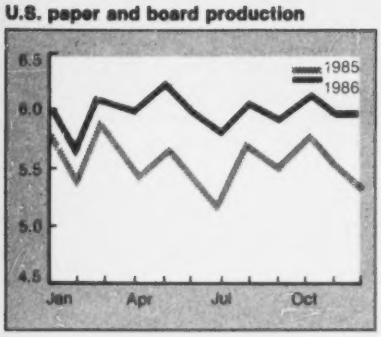
U.S. paper and board production



U.S. production of paper and paperboard totaled 5.9 million tons in December, up a very strong 9.9% from the previous year, according to American Paper Institute data. Output was unusually strong in December, the API said, as many producers kept machines running through the holiday shutdown period to keep up with heavy demand. Thanks to the strong December finish, production for the year topped 71.0 million tons. That is 5.9% higher than in 1985 and 3.7% above the previous record set in 1984.

Among major grades, record fiber box demand fueled a 7.6% increase in containerboard production for domestic use. Total linerboard exports jumped almost 20%, thanks to a steep decline in the value of the dollar. Continued growth in markets for computer, office, and offset papers fueled a 7.7% rise in uncoated freesheet shipments for the year. Newsprint production rose 3.7% compared with 1985, while operating rates climbed to 96% of total capacity.

Canadian newsprint shipments ended the year at 9.3 million tons, up 3.4% from 1985. Operating rates reached 94%, up from 92% in 1985. Woodpulp shipments jumped 9.5% for the year, with operating rates of 92%, up from 87% in 1985. ■

	Latest month (000 short tons)		% change from year ago	Annualized year-to-date (000 short tons)	% change from year ago
PAPER & PAPERBOARD PRODUCTION[1]					
Newsprint	Dec.	472	7.8	5,630	3.7
Uncoated groundwood (s)	Dec.	124	10.7	1,523	0.5
Coated paper (s)	Dec.	540	20.5	6,260	6.6
Uncoated free sheet (s)	Dec.	881	8.4	10,504	7.7
Other printing/writing	Dec.	108	−0.9	1,384	3.1
Total packaging and other paper (s)	Dec.	424	3.4	5,137	−1.3
Tissue	Dec.	424	3.4	5,096	3.1
Total paper	**Dec.**	**2,972**	**8.5**	**35,534**	**4.4**
Unbleached kraft paperboard	Dec.	1,531	16.4	17,694	7.7
Semichemical medium	Dec.	438	5.8	5,373	5.6
Bleached paperboard	Dec.	365	10.6	4,293	8.7
Recycled paperboard	Dec.	625	4.5	8,143	6.7
Total paperboard	**Dec.**	**2,959**	**11.4**	**35,503**	**7.5**
Total U.S. paper and paperboard output	**Dec.**	**5,931**	**9.9**	**71,036**	**5.9**
PULP, WASTEPAPER & FIBER[2]					
Total U.S. woodpulp production	Nov.	4,781	6.3	57,256	5.5
Market pulp production	Nov.	651	11.3	7,508	10.2
Wastepaper consumption at paper/board mills	Nov.	1,398	8.7	16,626	8.2
Pulpwood consumption (cords)	Nov.	7,681	8.0	91,243	6.1
CONVERTED PRODUCTS STATISTICS[3]					
Corrugated box shipments (billion ft²)	Dec.	22.03	12.4	283.62[6]	6.0
Containerboard inventories at U.S. box plants and mills	Dec. 1	2,138	−13.4		
INTERNATIONAL TRADE[2]					
U.S. paper imports (including products)	Nov.	1,134	23.8	11,743	5.4
Imports of Canadian newsprint	Nov.	767	14.1	8,390[6]	3.2
U.S. paper exports (including products)	Nov.	396	22.6	4,681	16.7
Exports of unbleached kraft linerboard	Nov.	175	38.9	2,159	19.5
Exports of woodpulp	Nov.	312	−14.0	4,417	15.8
Norscan pulp inventories[4]	Dec. 31	870	−33.0		
Norscan pulp operating rates[4]	Dec.	95%	97%	96%	93%
CANADIAN STATISTICS[5] *(reported in metric tons)*					
Total newsprint shipments	Dec.	815	4.9	9,302[6]	3.4
Operating rates	Dec.	96%	87%	94%	92%
Inventories held by U.S. consumers	Dec. 31	1,257	−9.8		
Other paper/board shipments	Dec.	485	19.2	6,017	10.4
Woodpulp shipments (export only)	Dec.	689	9.7	7,674	9.5
Operating rates	Dec.	88%	78%	92%	87%

1. American Paper Institute. 2. API, Bureau of Census, American Pulpwood Assn. 3. Fibre Box Assn., Paperboard Packaging Council. 4. North American/Scandinavian paper-grade market pulp. 5. Canadian Pulp & Paper Assn. 6. Not annualized. (s) = Shipments.

COATED FREE-SHEET: Analysts expect healthy growth of product demand in 1987

Grade structure: Coated free-sheet grades consist of papers made from no more than 10% groundwood pulp, most commonly stone groundwood; the balance is chemical pulp. Coated Nos. 1 and 2, at the top of the quality range, have no groundwood content at all, while Nos. 3 and 4 may contain small amounts or none. About half of the No. 4 group is excluded from the free-sheet category due to groundwood pulp content. Most coated free-sheet paper (93%) is coated two-side (C2S). Most of the 385,000 tpy of coated one-side paper (C1S) is free-sheet.

Basis weights for premium coated Nos. 1 and 2 are generally between 60 and 100 lb, while Nos. 3 and 4 generally are in the 25-to-90-lb area. Most coated free-sheet is used by commercial printers. The largest end uses are annual reports, catalogs, and other advertising and promotional materials. An important end use is in magazines for cover stock and higher-grade interior pages for artistic and other first-class publications. About 10% of No. 3 is used by magazine publishers.

Coated papers come in glossy, dull, matte, and embossed finishes. Measurements of these finishes (Gardner gloss meter) are 45 or more for glossy, as low as 25 for dull, and 20 or below for matte.

A survey conducted in the early 1980s estimated that about 65% of all No. 1 was glossy and 35% was dull, with a very small share for matte and embossed. For No. 2, about 80% was glossy and 16% dull. For No. 3, the division was 63% glossy, 33% matte, and 3% dull. Embossed represents less than 2% of any grade.

Production/capacity: Analysts predict that operating rates will remain at a healthy 92% to 93%, about the same as 1986. Output of coated free-sheet from U.S. mills rose 1.7% in 1986 from 1985 but will jump to somewhere near the greater-than-7.8% rise in capacity in 1987, to about 3.1 million tons.

Scott Paper Co.'s S.D. Warren Div. in Skowhegan, Maine, brought its 215,000-tpy coated free-sheet machine online near the end of 1986. No new machines are definitely set for 1987, although Westvaco Corp. will add 30,000 tpy this year and 30,000 tpy in 1988, the final years of a five-year, 150,000-tpy program at its Luke, Md., mill. Mead Corp. will add 20,000 to 30,000 tpy at its Escanaba, Mich., mill through machine speedups and operating improvements. Midtec Paper Corp. will rebuild its off-machine coater at Kimberly, Wis.

Outlook: Future demand growth outlook for coated free-sheet grades is optimistic. Demand for coated free-sheet premium grades was rising as 1986 gave way to 1987, due in large part to demand for annual reports. Consumption is expected to be 4% to 5% higher in 1987 than in 1986 (based on *Blue Chip Economic Indicators*).

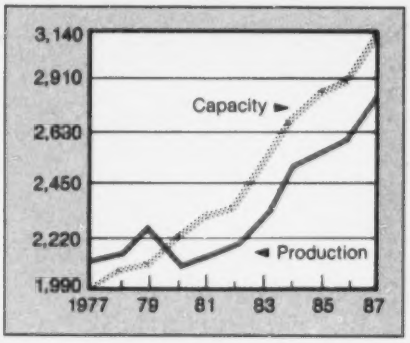
Backlogs were extending out past four or five weeks in some cases by the end of 1986.

Prices: Discounts plagued coated free-sheet grades throughout most of 1986, but at least four producers had announced price hikes for premium grades by Jan. 1, 1987. The $1,375/ton list price for No. 1, +70-lb in sheets had lasted since the beginning of 1985 and had suffered discounts to, and below, $1,325. However, a $40/ton price increase was instituted at the beginning of the year by four producers. The hike also affected No. 3, which rose from a $980/ton list to $1,020. However, the discounting that brought No. 3 to an average transaction price of $920 throughout 1986 continued into the new year. Scott's S.D. Warren Div. failed to support the hike, but observers expect the $40 increase to be in place about mid-year.

Typical historical pricing trends ($/short ton, average price for year) are as follows for 70-lb No. 1 sheets: 1978, $880; 1979, $939; 1980, $1,021; 1981, $1,096; 1982, $1,148; 1983, $1,213; 1984, $1,321; 1985, $1,375; 1986, $1,350. For No. 3 rolls: 1978, $621; 1979, $690; 1980, $750; 1981, $798; 1982, $798; 1983, $830; 1984, $919; 1985, $980; 1986, $940 to $950.

Markets: Commercial printing remains the largest consumer of C2S paper, while C1S is used primarily by label converters and wrap manufacturers. A substantial minority of No. 4 goes to magazine publishers, as does No. 3, either of which can be used for magazine cover stock. ■

SUPPLY/DEMAND (000 tons)



FORECAST (000 tons)

	1985[3]	1986[3]	1987e
Production[1]	2,618	2,640	2,849
Capacity[2]	2,845	2,892	3,120
Utilization rate	92.0%	91.3%	91.3%
Imports	103	100	114
Exports	39	41	57
Apparent U.S. consumption	2,682	2,699	2,906
lb/capita	22.40	22.34	23.90
GNP ratio	1.50	1.47	1.54

1. *P & P* estimate.
2. API capacity survey.
3. Revised

TOP U.S. PRODUCERS (000 tpy)

	Annual capacity	Market share (%)
1. Scott Paper[1]	850	27.2
2. Westvaco	475	15.2
3. Mead Corp.	415	13.3
4. Champion Intl.	265	8.5
5. Potlatch[2]	220	7.1
6. Consolidated	215[3]	6.9
7. Simpson	185	5.9
8. Midtec	137	4.4
9. Newton Falls	100	3.2
10. Boise Cascade	54	1.7

Market share of top five companies: **71.3**

Market share of top ten companies: **93.4**

Total U.S. capacity (1987): **3.120 million tons**

1. S.D. Warren Div.
2. Northwest Div
3. *P & P* estimate.

SALES & EARNINGS

1986 earnings rose, thanks to weak dollar

The U.S. paper industry is on a roll: 1986 earnings were up 29.7% from 1985. Sales improved 4.4% in 1986. Paper/forest products companies in the fourth quarter enjoyed their third consecutive rise in earnings. Producers of market pulp, linerboard, and uncoated free-sheet showed the biggest gains.

As was true most of last year, the weak U.S. dollar deserves much of the credit, helping to boost export volume and prices. The improvement in export markets helped the domestic supply/demand balance for many commodity grades and enabled producers to push through price increases from depressed 1985 levels. The beneficial effects of cost-cutting programs have begun to kick in. And despite the loss of investment tax credit under the new tax law (retroactive to Jan. 1, 1986), many companies still recorded substantial improvements in earnings during the latest quarter.

As George Weyerhaeuser, president and CEO of Weyerhaeuser Co., put it, "for the first time in the 1980s, all the major domestic and international market trends are working in our favor."

International Paper Co., the nation's largest paper company, saw income from its continuing operations more than double to $305 million compared with a 48% decrease from 1984-85. John A. Georges, chairman and CEO, attributed the turnaround to the dollar and "stringent cost-reduction efforts, improved productivity from major capital programs, and lower energy prices." As for this year, Georges predicted the earnings momentum would continue, "absent a downturn in the economy or any unfavorable trend in the value of the dollar."

Second-largest James River Corp. (on a fiscal year) reported an 85% increase in sales for its second quarter ended Oct. 26., excluding a $19.4-million charge inflicted by the new tax law. The company said the strong performance was due to the acquisition of Crown Zellerbach Corp. and better prices in uncoated white printing paper and pulp. It noted prices "remained highly competitive in consumer towel and tissue products and disposable food service products, although strengthening occurred at the end of the quarter in both food service and away-from-home towel and tissue products."

Champion International Corp. recorded a 23% improvement in earnings to $200.8 million, although sales of $4.38 billion were off 24%. The company said its restructuring program, effective July 1, 1986, resulted

U.S. paper/forest products industry results for 1986.

Paper companies	Full Year (1986) Sales	Change 1986/85	Earnings[1]	Change 1986/85
Boise Cascade	$3,790,540	1.4%	$ 101,540	−2.6%
Bowater Inc.	919,690	1.7	49,444	−26.7
Champion International	4,397,623	−24.9	200,832	23.1
Chesapeake Corp.	599,770	33.4	13,738	−12.5
Consolidated	853,040	−8.7	67,542	−16.1
Federal Paper	948,580	21.0	33,353[2]	199.5
Fort Howard	1,649,290	13.6	146,391	−6.8
Georgia-Pacific	7,223,000	7.5	295,933[2]	57.4
Great Northern Nekoosa	2,040,000	5.2	85,300	84.6
International Paper	5,500,000	22.2	305,000[2]	129.3
James River (10/26)				
Jefferson Smurfit	944,366	49.8	26,003	66.4
Kimberly-Clark (10/26)	4,303,100	5.6	269,400[2]	0.86
Longview (10/31)	487,685	6.2	33,484[2]	49.4
Louisiana-Pacific	1,506,200	19.5	64,910	164.5
Mead Corp.	3,217,700	17.4	109,300[2]	13.0
Pope & Talbot	289,085	−10.0	15,815	137.9
Potlatch Corp.	976,373	2.7	69,943	85.7
Scott Paper	3,437,000	12.7	186,500[2]	−7.2
Sonoco Paper	963,796	10.8	54,676	10.7
Southwest Forest	631,487	8.5	7,228[2]	n.m.
Temple-Inland	1,296,800	4.2	80,800	−6.1
Union Camp	2,045,215	9.6	129,934	38.6
Wausau (11/30)				
Westvaco (10/31)	1,811,937	5.2	108,096	3.3
Weyerhaeuser	5,652,029	8.6	276,885	38.3
Willamette	1,200,155	4.2	74,866	23.9
Total	$68,379,491	4.4%	$2,690,984	29.7%

1. Income after taxes, from continuing operations, excluding most significant nonrecurring items in both years.
2. **Federal Paper Board:** Year excludes $15.1-million charge for early redemption of notes. **Georgia-Pacific:** Year includes $33-million gain from sale of certain stock and warrants. Year net excludes $17-million gain from change in accounting for pensions and cumulative effect of new timber capitalization program. 1985 quarter and year net exclude $10-million gain from court settlement. 1985 year excludes $30-million loss from discontinued operations. 1985 net excludes $19-million gain from sale of timberlands. **International Paper:** Year includes $10-million net gain relating to sale of headquarters building. Full year net also includes these pretax items: $32-million gain on offerings of depositary units of IP Timberlands Ltd.; $44-million gain from change in pension accounting; $20-million loss from rise in income taxes. 1985 net includes $56-million gain on IP Timberlands offering; $12-million loss from discontinued operations; $29-million charge for early retirement program. Note: **Hammermill Paper** will not publish annual results for 1986 since it was purchased by IP. **James River:** Excludes a $19.4-million charge due to impact of Tax Reform Act. Note: Sale of Crown Zellerbach Corp.'s Distribution Group to Mead Corp. in September did not have a significant impact on James River's earnings. **Louisiana-Pacific:** 1986 year net excludes $29.4-million gain due to change in accounting method for investment tax credit. **Mead:** Year net excludes $65.9-million loss from discontinued operations. **Scott Paper:** 1986 net includes $35-million pretax loss from effects of new tax law and nine-week strike at Mobile, Ala., mill. **Southwest Forest Industries:** Year net excludes $10.366-million charge related to the conversion of debentures.

n.m. = Not meaningful.

in cutting corporate expense by $84 million to $62 million.

Field day for market pulp. Weyerhaeuser Co. enjoyed record sales for the fourth quarter of $1.45 billion—a 17% improvement over the year-earlier quarter. For the year, sales improved 8.6% to $5.65 billion while earnings rose 38.3% to $276 million, despite long strikes in Weyco's forest products operations in the Northwest and British Columbia. Again, the weak dollar and cost improvements were lauded. George Weyerhaeuser predicted "pulp and paper product markets in 1987 should be considerably stronger than those of 1986, and recent upward trends in log export prices and volumes should combine with continuing strong demand for wood products in domestic markets." Weyco and other companies that sell timber stand to gain from the 15% export fee Canada recently placed on softwood lumber exports to the U.S.

In addition to experiencing a record year in its building products business, Georgia-Pacific Corp. reaped in the benefits of strong demand for pulp, paper, and paperboard. Earnings for the year showed an increase of 57.4%, to $295.9 million on sales of $7.22 billion.

Great Northern Nekoosa Corp. saw its earnings increase 85% to $85.3 million on sales of $2.04 billion. Chairman of the company, William R. Laidig, said that paper prices are approaching their highest levels since 1984, and he doesn't foresee any sudden backsliding because paper companies haven't added much capacity.

Paperboard surging. Union Camp Corp.'s 1986 sales broke the $2-billion mark for the first time, while earnings rose 36.6% to $129.9 million. Fourth-quarter earnings of $42.8 million were the largest in company history and more than double the 1985 period. Increased shipments of linerboard made up a large part of the 14% increase in paper product shipments that the company enjoyed. It ran its kraft paper and board mills almost full-out last year. Demand was also strong for Union Camp's printing and writing papers. The company expects profits in 1987 to be helped by the price increases for corrugated containers, which are overdue compared with strong linerboard price levels.

Federal Paper Board Co.'s 1986 earnings were about 200% higher than 1985 levels at $33.5 million. Earnings improved quarter-by-quarter because of strong pulp and bleached board markets. John R. Kennedy, company president, noted, "As we begin 1987, all our operations are running well. Order backlogs are generally good, and sales prices are improving." Potlatch Corp. enjoyed an 85% increase in earnings to $69.9 million on slightly improved sales of $976 million.

Tissue holds its own. Tissue producers, dueling in a cut-throat market while paying higher and higher prices for pulp, are holding their ground. Kimberly-Clark Corp. reported record sales and earnings for fourth-quarter and full-year 1986. However, 1986's earnings of $269.4 million were only a 0.86% improvement in earnings over last year. K-C said that U.S. sales of its disposable diaper products improved, "despite higher costs associated with the national introduction of the Huggies Supertrim diaper." Healthy results were also turned in by household products, feminine care, and the professional health care sectors. This year, K-C projects increased sales of disposable diapers will improve its profitability.

Scott Paper Co. enjoyed its third consecutive record year of sales at $3.43 billion. Earnings would have been up about 10% to $221 million except for the combined effects of the new tax law and a prolonged strike at the Mobile, Ala., mill, which amounted to a pretax charge of about $35 million. Scott's worldwide sanitary paper business, including U.S. operations, achieved record sales revenue, increasing 14% to $2.3 billion. Outside of the U.S., earnings from sanitary paper products almost doubled, helped by the weak dollar. Scott's S.D. Warren Co. also had record sales of $921.2 million, up 9% from 1985, helped by strong demand for the division's LWC paper.

Wood products stronger. Louisiana-Pacific Corp. enjoyed record sales and hugely improved earnings in 1986. Sales of $1.5 billion were 22% higher than they were in 1985. "We experienced solid building products markets, aggressive cost control, and a dramatic turnaround in our pulp and paperboard segment," enthused the company's chairman and president, Harry A. Merlo.

Southwest Forest Industries Inc. showed that it had recovered from a tough 1985: earnings were $7.2 million compared with a loss of almost twice that amount in 1985. ■

ACQUISITIONS/MERGERS

Stone Container to get SFI in friendly takeover

Stone Container Corp. has signed a definitive merger agreement to acquire all of the outstanding shares of Southwest Forest Industries Inc. for $32.25 per share. This comes out to approximately $763 million, including assumption of debt and redeemable preferred stock. The agreement will increase Stone's leadership position in the containerboard/corrugated box business and mark the company's diversification into newsprint and market pulp. As in four earlier acquisitions over the past four years, the company will aggressively leverage its financing.

SFI has been the object of takeover speculation for several years, but the deal is a "totally friendly one," according to Stone's senior vice president and chief financial officer, Arnold F. Brookstone. As part of the agreement, SFI directors voted to redeem for $0.25/share the company's shareholders rights, a defense adopted by the company in 1984. Closing, still subject to several conditions, including approval by Southwest Forest Industries' shareholders, is expected to take place in early April.

Major assets to be acquired as part of the agreement include SFI's Snowflake, Ariz., and Panama City, Fla., pulp and paper mills, 19 corrugated box or sheet plants, and a number of wood products plants. In addition, the company owns 334,000 acres of private fee timberland in Florida, Georgia, and Alabama. The Snowflake mill has capacity to produce 280,000 tpy of newsprint on two machines and 160,000 tpy of linerboard on a third machine. The Panama City mill has capacity to produce 280,000 tpy of linerboard on one machine and also has a pulp dryer with which to produce 240,000 of bleached softwood and hardwood market pulp.

Newsprint—a new growth area. Roger W. Stone, chairman and chief executive of Stone Container Corp., described the newsprint and market pulp operations as "important and highly desirable product line extensions," which he said had a very favorable supply/demand outlook.

According to Brookstone, the company has been considering expansion into the newsprint field for quite some time and plans "one way or

Formulators for deinking cut into commodity's share

WASTEPAPER USE UP IN 1986. About 22 million tons of wastepaper were collected in the U.S. in 1986, 83% of which was for domestic use. This is nearly one-quarter of the fibrous raw material used in paper and paperboard operations and represents an 8.6% increase over 1985. The chief reason for the increase was the significant growth of paperboard production and the continued acceptance of integrating wastepaper into furnishes. Exports are also reaching record levels as shipments overseas saw an 11% increase over the previous year.

Domestic use was highlighted by capacity expansion at a number of locations. In the South, Cheaspeake Interstate, and Packaging Corp. of America collectively contributed over 400,000 tpy to wastepaper use. Temple-Inland opened its new 515-tpd recycled linerboard in Ontario, Calif.

Another half million tons of growth in wastepaper use is proposed in the U.S., and one major project in Canada (Ontario Paper Co. Ltd., Thorold, Ont.) is due online in 1987 with capacity at 170,000 tpy. Many other linerboard mills are using existing or new equipment (primarily pulpers) to facilitate the use of wastepaper in accordance with fiber supply interruptions, machine speedups, and as a production cost reducer. To a lesser extent, market pulp, tissue, and some fine paper producers have made similar moves but only in cases where wastepaper supply (mostly reject material from virgin fiber plants) can be easily collected.

CHEMICAL SALES BENEFIT. Not surprisingly, most chemicals for secondary fiber treatment enjoyed a successful year. The leader among those was the surfactant-based formulations. The consumption of commodity chemicals such as sodium silicate and caustic soda remained flat due to the increased attention of both suppliers and mills to reducing the raw material variations inherent to wastepaper processing. Although commodity surfactants are much cheaper than the specialty formulations, the benefits of service and reliability from a supplier are seemingly more important.

Mills are requesting more from deinking chemicals than in the past. Producers are looking for more cost-effective chemicals to reduce repulping time, control stickies and other contaminants, and enhance production through tonnage increases and/or improved product quality.

Among the more difficult contaminants being challenged in mills and supplier laboratories are laser ink, widely used copier inks, and hotmelt adhesive materials, now seen as a chief source of stickies.

Sodium silicate consumption is decreasing in all deinking systems. The typical addition range, 2% to 6% based on the weight of fiber, is decreasing because of the users' ability to more efficiently use the chemical in combination with new supplier offerings. The detergent action of this combination appears increasingly effective and reduces opportunities for silicate use. Silicate still has a bright future in peroxide stabilization, influent treatment, and as a strength/fire-retardent additive in converted paper products.

The prices of deinking chemicals did not change much in 1986, and no new changes are expected for this year. Sodium silicate has remained level throughout this decade, but caustic has fluctuated due to shifts in supply and technology by the major chloralkali manufacturers. Sources say that the 1990s may bring an upward cost spiral for chloralkali products because of the changes made during the 1980s. The formulated products span a wide cost range, but usually they fall between $1 and $2/lb. Suppliers mentioned that no price hikes will occur in 1987.

One company on the move in specialty chemicals is PPG Industries. PPG has acquired Santek (Appleton, Wis.), Mazer (Gurnee, Ill.), and Jordan (Folcroft, Pa.); the first two already supply the paper industry with process aids, mostly on a customized basis. PPG has for many years been a chloralkali supplier, but with a strong company based in papermaking aids (Santek) and one to supply the components (Mazer), PPG has moved toward being a major supplier of specialty chemicals to the industry.

EMPHASIS ON QUALITY. The demand for more attractive products in newsprint and tissue is putting pressure on manufacturers to offer a higher-quality basestock to printers and converters. Deinked pulp is becoming whiter, brighter, and more flexible for further processing due to these factors. One chemical receiving more attention as a process aid is hydrogen peroxide. Peroxide attacks the ink binder and assists in making the binder soluble.

— Michael Ducey

TABLE 1: **Consumption and price of chemicals used in secondary fiber processing.**

Chemical	Recycling (short tons)	Change (1986/1985)	All industry (000 short tons)	Price[1] ($/lb)
Caustic	13,100	6.5%	11,900	0.975
Sodium silicate	11,500	−1.0	823	0.1570
Hydrogen peroxide	5,500	8.6	9,150	0.325[2]
Surfactants	14,000[4]	10.0	3,800,000	0.75-2.10[3]

1. Source: *Chemical Marketing Reporter.*
2. 50% basis.
3. Represents a range corresponding to use in formulations used by suppliers to the pulp and paper industry.
4. Adjusted number.

CROSS-DIRECTION CONTROL SALES HAVE DOUBLED IN THE PAST TWO YEARS

Exclusive *P&P* survey finds that CD actuators are now standard equipment on machines; more than 1,800 systems are installed

By KENNETH E. SMITH, Executive Editor

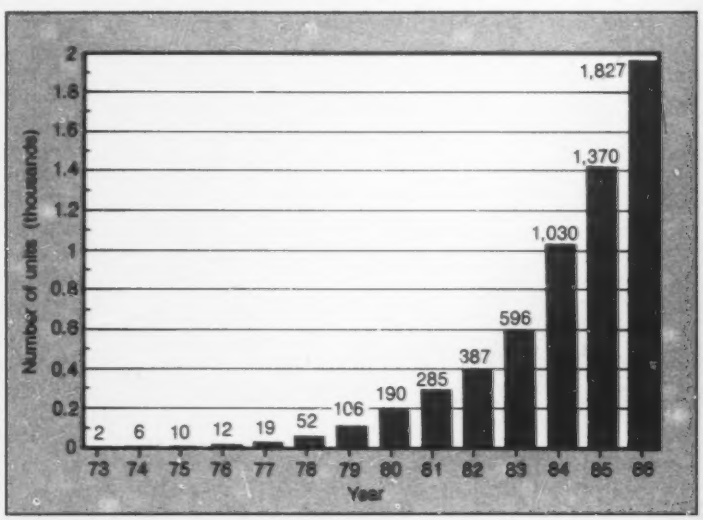
In its February 1985 issue (p. 72), *P&P* surveyed cross-direction (CD) paper machine control installations and found that 960 actuators had been sold and installed under closed-loop control worldwide through the end of 1984. The first CD actuators—caliper controls on newsprint machines—were installed in 1973. Since that time, CD control of basis weight, moisture, and caliper has gained universal acceptance. The increase in the number of installations during the 1980s has been dramatic. *P&P* again surveyed CD installations and found that the number has almost doubled in the past two years,* thanks to increased industry emphasis on quality, improved sensors and actuators offered by existing vendors, and expansion of the market through several new vendors. Through the end of 1986, an estimated total of 1,827 CD controls had been installed (Figure 1).

* Please note in Figure 1 that the 960 figure for systems sold through the end of 1984, as reported in the previous survey, has been revised to 1,030.

There are several theories as to which CD control is the most important, and, of course, this will vary with grade. One theory says that basis weight is the most important since an uneven weight profile will have an adverse effect on moisture and caliper. Moisture is said to be the easiest application to justify economically since evening moisture profile usually allows a higher target sheet moisture to be run. Caliper is extremely important to printing/writing grades; however, most new machines in this market, such as Georgia-Pacific Corp.'s at Port Hudson, La., and Hammermill Papers Group's at Selma, Ala., have been started up with actuators for all three applications.

Donald Brewster, president of Profigard Inc., Montreal, Que., recently reported that "moisture is clearly a pivotal variable. Improvement of the moisture profile makes it easier to control caliper and hence roll condition and surface properties. Moisture profile improvement also provides freedom to level the dry weight profile, which is frequently distorted to compensate for an inherently poor moisture profile." Apparently most of the industry believes in this strategy because CD moisture control applications, at 737, are the most

FIGURE 1: **Accumulation of all CD actuators, sold under control.**



numerous through the end of 1986, with 201 systems installed in 1986 alone (Figure 3).

CD caliper control—despite being the oldest form—is only the second most common with, 648 total installations through the end of 1986 (Figure 4). Basis weight is the most complex CD control and is also the least common with 462 installations (Figure 2).

VENDORS ENHANCE SYSTEMS. Sentrol, which installed the first CD controls, has had only a minor share of the market recently and reports a total of 70 installations. Sentrol does not supply actuators but instead prefers to work with Devron-Hercules equipment. Since 1986, Sentrol is completely owned by Valmet Automation, which is owned by Valmet Paper Machinery Inc. Wartsila, also a part of this company, has applied CD control to gloss on supercalender installations, and Sentrol will offer this technology.

Early this year Sentrol brought out its new Optiscanner, a scanning sensor platform that it says is designed to improve reliability and serviceability for its sensors. Sentrol has also introduced the Sentry XD paper machine control system, which is said to offer superior software and a high-speed host processor with on-board memory that networks a series of distributed, dedicated single board processors.

Measurex is still the industry leader with a total of 890 CD installations. Measurex added a caliper actuator, the Caltrol, to its product line in 1985 and now provides a complete set of actuators. Approximately 80% of Measurex's CD applications during the past two years utilized its own actuators.

According to the company, the Caltrol provides the largest control range in the industry, with an operating range of 80° to 160° F. The roll wrap is engineered for each application and coupled with a center-exit, high-velocity air impingement design. The Caltrol has reportedly been successfully used to control coat weight pickup on an on-machine coater. Applied to the precoat calender stack, coating pickup at one slice position can be changed by over 2 lb/3,300 ft².

Measurex subsequently became involved in a patent dispute with Impact Systems, which claimed that the Caltrol infringed on the patent for its Therma-Jet caliper actuator, which was introduced in 1984. Measurex claimed that the original idea for the actuator was taken by Impact officers who were formerly employed by Measurex. The dispute was settled with Impact retaining the patent and granting Measurex a nonexclusive, nontransferable license to make the actuators. Measurex, in turn, will provide Impact with guaranteed access to Measurex communication links for use with Impact's actuators at reduced fees.

In 1986, Measurex introduced its Thermatrol II basis weight profiling system. This system utilizes Equilex thermally controlled slice rods from Chleq Frote in France. Control rod stiffness is matched to the slice lip, which reportedly eliminates the need for a slice position feedback system. Cooling air is directed around and through the rods to reduce response time. The Thermatrol II also includes an optional heating element monitor for detecting loss of power.

Measurex's Vision 2002 ET control system, which was introduced in 1986, contains several features designed specifically to improve CD control. Its Autoline is designed to match CD measurement zones with the control zones. According to Profigard's Brewster, "phantom error" profiles due to mismatching measurement profiles to the actuator array often substantially degrade achievable profile uniformity. Measurex's Slice Trak is reported to adjust displayed and controlled profiles for varying degrees ofshrinkage across the web. In the sensor area, the company's Ultrascan reportedly increases the scanning rate across the web to 12 in./sec,

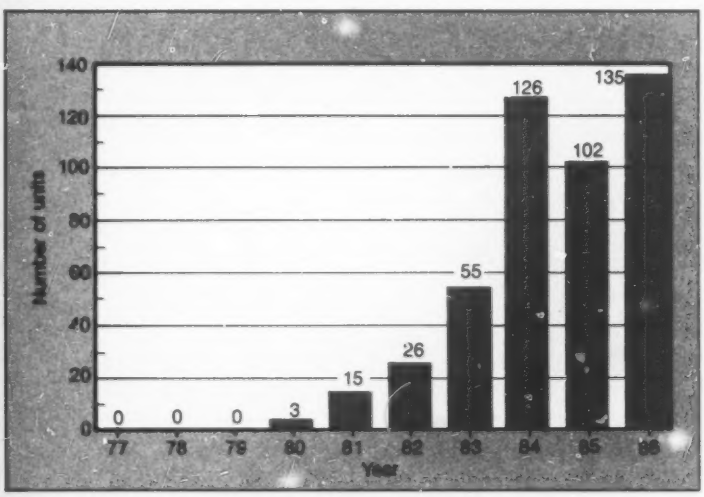
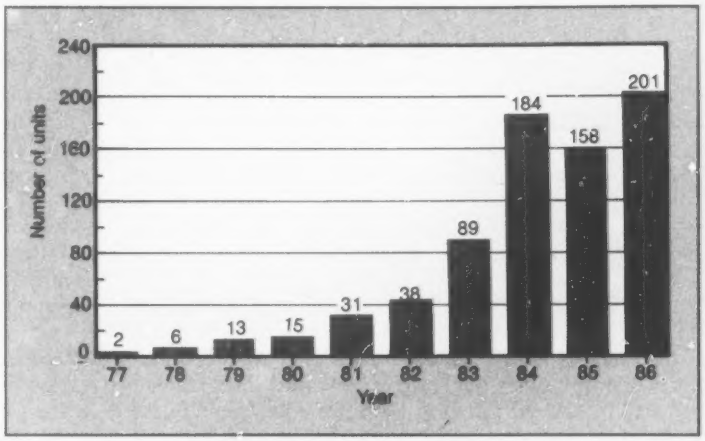


FIGURE 2: **Basis weight CD controls sold.**

FIGURE 3: **Moisture CD controls sold.**



and the Ultratune dynamically separates machine direction variations from the true CD profile. These enhancements are reported to allow determination of the CD profile in one-tenth the time required by conventional scanning systems.

COMPLETE ACTUATOR LINES. AccuRay, which had previously worked with "preferred" actuator suppliers, introduced its family of Microset actuators in 1986. This includes the Linear Stepper Slice Actuator, the Water Spray, and the Thermo-Profiler. AccuRay will also bring out its Microset Steam Profiler in early 1987. AccuRay reported 282 CD applications for the past two years, and is second in number of total installations with 623. Because its line of actuators is relatively new to the industry, only 60% of AccuRay's CD installations in the past two years utilized its own actuators; however, the company expects to see a significant increase in this percentage.

The Linear Stepper Slice Actuator uses pressurized air to achieve rotational movement of harmonic gears within the actuator. This rotational movement is then converted into linear movement of the slice lip. AccuRay holds two patents on this design and claims three times better resolution than other slice actuator types. The Water Spray actuator is water-pressure-atomized with spray modules consisting of four nozzles controlled by four digital stainless steel valves. The Thermo-Profiler caliper actuator utilizes high-temperature, low-volume air flows. Control segments are typically 4 in. in length. The Steam Profiler applies high-velocity steam in three zones, front and back sealing zones and the profiling zone, to the web. The profiling zone is compartmentalized—typically in 6-in. segments—with steam supplied to each zone through a separate actuation valve.

AccuRay was acquired by Combustion Engineering in 1986. C-E reportedly plans to integrate some of its Taylor Instruments operations with AccuRay at Columbus, Ohio. Impact Systems has filed suit against AccuRay and alleges that AccuRay's Thermo-Profiler infringes on the Therma-Jet patent.

NEW MOISTURE SENSOR. Impact Systems, which first introduced the high-intensity infrared CD moisture actuator to the industry in 1981 as its Infra-Pac, now is offering a complete line of actuators with the introduction of its Dyna-Flex CD basis weight control system. The company sold 221 actuators in the last two years. Impact has sold a total of 243 CD control and coating drying systems, of which more than 100 are equipped with "stand-alone" closed-loop control systems that rely on a serial link to the scanning sensor system supplied by another vendor. However, Impact is also entering the sensor business with the introduction of its RT nonscanning moisture sensor.

The Dyna-Flex system is a water-based hydraulic slice lip control system with a reported range of 0 to 0.6 in., backlash compensation, and bumpless transfer both ways on power failure. Impact's RT moisture measurement system consists of a stationary array of sensing elements placed in 3-in. zones across the sheet, which are said to be capable of measuring CD directional data every two seconds.

Early this year, Impact announced a five-year warranty on its Therma-Jet actuator, which it says is the longest available for any caliper control device.

Devron-Hercules, the leading supplier of CD actuators, reports approximately 800 installations in 32 countries. The mainstays of its product line have been the popular Calcoil induction heating caliper profiler and the Devronizer steam box for hot pressing and moisture profiling. Devron developed the thermal-hydraulic type of CD basis weight actuator and has incorporated this principle into its Auto-Slice system. The company also offers Auto-Slice systems with motorized control gears and with pulsed harmonic actuators which utilize a combination of high-ratio harmonic gears coupled to either air or electric motors. Devron recently complemented its line of products with the Hydro-Profiler water pressurized rewetting system for moisture profiling and the Calenderizer steam shower for improving sheet smoothness and gloss profile at the calender stack through the process of hot calendering. Devron-Hercules' research of applications of both the

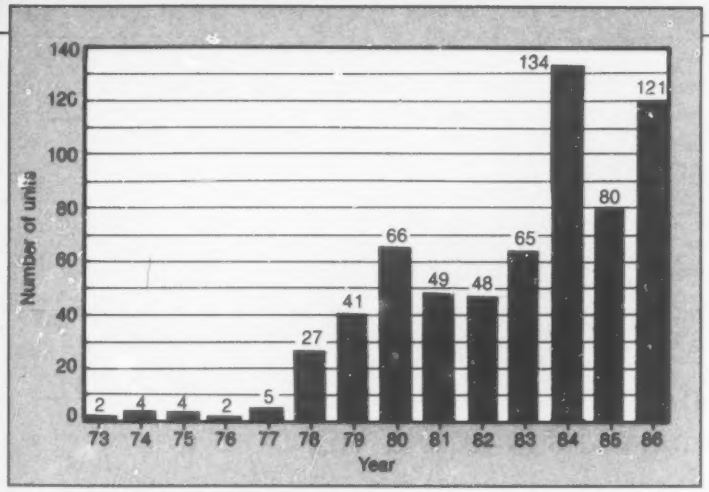


FIGURE 4: **Caliper CD controls sold.**

Calcoil and the Calenderizer on supercalenders has reportedly produced promising results.

Devron-Hercules also entered the infrared moisture profiling market in early 1987, introducing its Infra-Dry electric infrared system for moisture profiling and coating drying. The Infra-Dry is a high-power density drying system using segmented electric infrared modules. The system is designed with 6-in. modules rated at 20 kW mounted side-by-side across the paper machine and with individual power level control for each module. Infrared energy is directed by gold-plated reflectors toward the paper web for high energy efficiency.

V.I.B. Systems Inc. is the leading supplier of rewetting systems for CD moisture control. V.I.B.'s original systems were air atomized water sprays with flow to a single row of nozzles regulated with flowmeters and needle valves. The latest systems are water pressure atomizing, and feature groupings or modules of nozzles with flow regulated by digital valves on or off. Standard nozzle spacing is 6 in.

V.I.B. is one of AccuRay's preferred actuator suppliers and manufactures AccuRay's Microset Water Spray and Steam Profiler systems to AccuRay specifications. V.I.B. has more than 1,200 water spray installations worldwide. A very few of these installations are equipped with stand-alone controls.

EVAPORATIVE COOLING CALIPER CONTROLLER. Three new CD control actuators are being offered by Thermo Electron Web Systems. Its Moisturizing Shower is of 316 stainless steel construction with a 15-step low-voltage control to produce hydraulic atomization. The Steamfoil steam shower features a parallel, counterflow steam application through a nozzle design utilizing the Coanda effect, which has been used in the company's Thermofoil flotation drying systems. Thermo Electron says that the Steamfoil can be applied in the press section and at the calender stack to enhance gloss and smoothness.

The company's newest and most innovative product is its Mystifier caliper profiler. The Mystifier applies evaporative cooling with individually controlled channels on 3-in. centers. The cooling fog produced by the Mystifier is said to be 20 times more powerful than cold air showers and twice as powerful as devices utilizing heat. The Mystifier is mounted 9 in. from a calender roll. The cooling fog is administered by individual banks of nozzles, each controlled by separate stepping motor-driven valves for accurate applications. The unit is reported to require only one-twentieth of the power consumed by cold air shower actuators.

Thermo Electron will supply its T/E NET control system with all its CD actuators. This system utilizes a high-resolution, yellow-on-black electroluminescent control module that permits control of all functions via a touch screen. This system is designed to stand alone or integrate with existing process controls.

Albany International's Engineered Systems Div. will introduce a full-width, online system to measure CD formation based on light intensity variations in early 1987. Formation values from the system, called the Formspec, are said to compare favorably with visual inspections, and the system is claimed to be a breakthrough in measuring this higher level paper quality online. Albany International feels that with this sensor papermakers will close the loop on formation, utilizing formation showers, drainage devices, and other actuators to control CD formation.

THE FUTURE. CD controls are now considered as essential to papermaking as machine-direction computer controls, which is evidenced by their installation on most new paper machines. Most paper machine equipment suppliers offer profiling equipment for retrofits and new machines. Vendors estimate that less than one-half of the CD control and actuator retrofit market is fulfilled. One leading vendor recently surveyed paper machines with its process control systems installed and found an average of 1.9 actuators per machine. With a potential of three to five actuator installations per machine, this obviously leaves a large sales potential. Vendors will compete fiercely for this market, and papermakers should benefit from the innovative new products that will be developed as a result of this competition. ■

WORLDWIDE USE OF ANTHRAQUINONE FOR PULPING CONTINUES TO EXPAND

Since its introduction in 1977, anthraquinone's use as an additive to increase pulp production has spread to more than 70 mills worldwide

By GERALD W. KUTNEY, Ph.D.

On Feb. 1, 1977, C-I-L Inc. presented the results of anthraquinone (AQ) pulping to the public for the first time at the Canadian Pulp & Paper Assn.'s Technical Section's annual meeting in Montreal, Que. The information spread throughout the industry in an unprecedented fashion. Mill trials in North America were carried out within a few months. The spark that this caused is reflected by the number of references to anthraquinones in the *Abstract Bulletin of the Institute of Paper Chemistry* between 1976 and 1981 (Figure 1). By November 1977, Mead Corp.'s Kingsport, Tenn., mill was using AQ on a continuous basis.

Today, more than 70 mills have continuously or intermittently used AQ pulping, and the number of mills that have conducted trials exceeds 100. Japan leads all countries in the adoption of AQ pulping, and at least 18 other countries have AQ mills. The following is a summary of known worldwide use of AQ.

Dr. Kutney is market research manager-Forest & Industrial Products, C-I-L Inc., Montreal, Que.

AQ IN AFRICA. The largest pulp company in Africa, Sappi Fine Papers (PTY) Ltd., has carried out trials at its Enstra mill on soda-AQ and NSAQ (neutral sulfite AQ). Sappi has also contemplated adopting NSAQ at its new Ngodwana mill (producing 750 tpd). A mill in Zimbabwe is believed to be using NSAQ. No other mills in Africa are known to use AQ, but mills in Malawi and Tanzania have expressed interest in AQ pulping.

ASIA. Information from this area of the world is scarce. Papers on AQ pulping have been reported from India, People's Rep. China, Taiwan, Korea, and Indonesia. Trials have been carried out by Central Paper Mills and Rohtas Industries Ltd. of India on the kraft-AQ

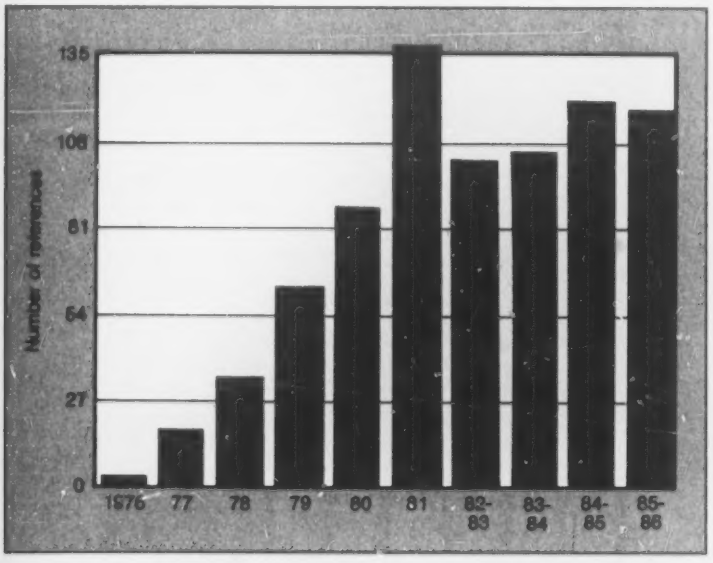


FIGURE 1: **Growth of references in the Abstract Bulletin of IPC (Institute of Paper Chemistry).**

pulping of bamboo. Laboratory studies on AQ pulping have appeared from the Saharanpur mill of Star Paper Mills Ltd., Andhra Pradish Paper Mills Ltd., and West Coast Paper Mills Ltd.

Several AQ mills may exist in People's Rep. China, where AQ apparently is very inexpensive. Soda-AQ pulping is replacing kraft pulping for wheat straws.

Nearly 56% of all pulp produced in Asia is manufactured in Japan. There are 38 reported AQ mills in Japan. The main additive used is DDA (dihydrodihydroxyanthracene), sometimes referred to as SAQ (soluble AQ). Details of DDA pulping at the Kushiro mill of Honshu Paper Co. Ltd. and the Hachinoke mill of Mitsubishi Paper Mills Ltd. have recently been reported.

AUSTRALIA, NEW ZEALAND. A kraft-AQ trial at the N.Z. Forest Products Ltd. mill at Kinleith resulted in a yield gain of 0.6% with addition of 0.02% AQ. Use of 0.1% AQ increased the yield by 1.2%. The use of 0.02% AQ was found to be "economic in most applications and particularly so for a recovery or causticizing limited mill." However, kraft-AQ was not adopted. Trials of NSAQ pulping at Kinleith and Whakatane were more successful, and continuous use resulted. Compared with NSSC, NSAQ reduced cooking times by 50% or cooking temperatures by 41°F. With reduced NSAQ pulping rates, pulp quality was found to be improved. A subsequent report stated that pulp production was increased by 40% at Whakatane, where AQ use has saved $250,000/year. At Kinleith, a high-strength pulp was produced that cannot be made by either the kraft or the NSSC process.

Australia Paper Mill's Burnie mill employs a soda-AQ process. The production rate has increased, and now hardwood-softwood mixtures can be pulped instead of just pure hardwoods. Pine alone has been successfully pulped in soda-AQ trials at Burnie. In October 1976, APM examined soda-AQ as a possible substitute for its kraft process at its Maryvale mill. Soda-AQ was not adopted, although it was reported that this pulp was a "satisfactory replacement (1:1) for kraft pulp in bag papers." In 1978 and 1979, soda-AQ semichemical pulping trials were also carried out at the Maryvale mill. The pulp was similar to NSSC pulp. Both Maryvale and its sister mill, Port Huon (240 tpd), have intermittently employed NSAQ since 1978. The Port Huon mill closed in December 1982.

TABLE 1: **Worldwide use of anthraquinone.**

Country	Number of AQ mills		
	Soda-AQ	Kraft-AQ	NSAQ
Argentina	n.a.	1	n.a.
Australia	1	trials	3
Austria	n.a.	trials	n.a.
Belgium	1	n.a.	n.a.
Brazil	n.a.	3	n.a
Canada	trials	1	trials
Chile	n.a.	trials	n.a.
China (PRC)	1+	n.a.	n.a.
Czechoslovakia	n.a.	1+	n.a.
Finland	n.a.	5	1
France	n.a.	1	n.a.
Germany	n.a.	n.a.	n.a
Italy	1	n.a.	n.a.
Japan	1+	35+	7+
India	trials	trials	n.a.
Mexico	1	n.a.	n.a.
New Zealand	n.a.	trials	2
Norway	n.a.	1	n.a.
Portugal	n.a.	trials	n.a.
Romania	n.a.	n.a.	n.a.
South Africa	1	trials	1
Spain	n.a.	3	0
Sweden	n.a.	2	n.a.
U.K.	1	n.a.	n.a.
U.S.	1	4	n.a.
U.S.S.R	n.a.	trials	n.a.
Uruguay	n.a.	1	n.a.
Zimbabwe	n.a.	n.a.	1

EUROPE. European AQ mills are currently concentrated in Finland and Spain. References to Finland are rare, but it is well documented that United Paper Mill Ltd.'s Tervasaari mill switched from sodium bisulfite to NSAQ in 1981. The mill produces 220 tpd of unbleached reinforcement pulp for newsprint and hypo-bleached pulp for printing grades. The NSAQ pulp can be used to replace high-yield kraft. Juntseno Pulp Co. has contemplated the conversion of one of its kraft mills to NSAQ. Several kraft mills may have adopted the use of AQ in Finland. Nik-Erik Virkola of Helsinki Univ. of Technology has presented the results from kraft-AQ trials taking place in Finland.

In Spain, the state-owned Empresa Nacional de Celulosa S.A. (ENCE) has adopted AQ for its kraft mills. AQ was found to be very effective for pulping eucalyptus. The three kraft mills of ENCE produce a total of 400,000 tpy. Trials have been held by many other major pulp producers in Spain.

The Soviet Union's pulp and paper industry has announced that it has plans to introduce the use of kraft-AQ pulping. At the Arkhangelsk forestry and Kherson complex, soda mills, possibly soda-AQ, have additionally been proposed.

In Sweden, several trials have been carried out (Munksjö AB carried out a kraft-AQ trial in 1979), and at least one mill is believed to be using AQ. In Belgium and the U.K., a soda-AQ process was being used, but these mills subsequently closed. In France, trials have been held, and one AQ mill may exist. Another is also believed to be operating in Italy. Trials have also been reported in Czechoslovakia, Portugal, Austria, and Norway. The trial in Norway was a 20-day trial that examined AQ and THAQ (tyrosine hydroxylase AQ). The process proved to be uneconomical and therefore was not adopted at the 500-tpd Moss mill, the world's oldest

operating kraft mill (since 1884). In addition, laboratory studies have been reported from Poland, Germany, Romania, and Bulgaria.

NORTH AMERICA. Mead Corp.'s soda mill at Kingsport, Tenn., has been using AQ since 1977. Addition of 0.06% AQ increased the pulping yield from 44% to 48%. Cooking time has also been reduced. The results of AQ trials on kraft, alkaline sulfite, and neutral sulfite pulping processes have been reported. A few kraft-AQ mills are operating in the U.S., and two further AQ mills may be operational in Mexico.

SOUTH AMERICA. The widespread use of AQ in Brazil has been claimed, especially when applied to the kraft pulping of eucalyptus. In South America, 56% of the continent's total pulp is produced in Brazil. Mills located in Uruguay and Argentina are believed to be using AQ. Kraft-AQ trials have been carried out in Chile, but no full-time adoption of the compound's use is believed to have occurred.

SUMMARY AND CONCLUSIONS. AQ pulping is now an established technology. Japan is believed to be the most advanced country in the world as to the industrialization of quinone additive cooking. Other countries where AQ pulping has become an integrated part of the pulp and paper industry include New Zealand, Australia, Finland, and Spain, among others. More than 70 mills all around the world have adopted this method. The only continent in the world that does not yet have an AQ mill is Antarctica.

This high adoption rate worldwide is extraordinary considering the major recession that the industry went through during the early portion of the 1980s. In North America, the relatively low rate of adoption of AQ can be attributed largely to this factor. The main reason for using AQ is to produce more pulp. During the recession, incremental pulp production was not needed. With the recession ending, however, interest in AQ pulping and its associated increase in pulp production is once again on the rise.

The number of AQ mills is expected to continue to increase around the world, especially in North America. By the year 2000, AQ pulping may become the standard pulping process. Just as kraft pulping displaced soda pulping and became known not as a modification of the soda process but as a distinct pulping technique in its own right, a similar destiny may lie ahead for anthraquinone pulping. ■

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